Operating Systems

Lecture 07: Managing Partitions and the Linux Filesystem

Managing Partitions and the Linux Filesystem

Create Partitions

- The hard disk is the most critical component for data storage in any system.
- Without effective disk partitioning, data on the disk will be unorganized and cluttered, or the users might run out of available storage space prematurely.
- Improper disk partitioning may also contribute to a system crash. As a Linux administrator, it is your responsibility to ensure that disks are partitioned properly

Managing Partitions and the Linux Filesystem

Filesystems

- A filesystem is a method that is used by an operating system to store, retrieve, organize, and manage files and directories on mass storage devices.
- A filesystem maintains information, such as the date of creation and modification of individual files, their file size, file type, and permissions, and it provides a structured form for data storage.
- A filesystem by itself does not interpret the data contained in files because this task is handled by specific applications.
- Filesystems vary depending on several parameters, such as the purpose of the filesystems, the information they store about individual files, the way they store data, and data security.

Managing Partitions and the Linux Filesystem

Filesystem Labels

- Filesystem labels are assigned to filesystems for easy identification.
- The labels may be up to 16 characters long and can be displayed or changed using the e2label command.
- The syntax for setting filesystem labels is
  - *e2label /dev/{device name}{partition number} {label name}.*
- They can also be set using the
  - *tune2fs -L {volume label} {device} .*

Managing Partitions and the Linux Filesystem

Filesystem Types

- Linux supports many common filesystem types. Some common filesystem types are described in the following table.

Filesystem Type	Description
ext2	This used to be the native Linux filesystem of some of the previous releases. It is still supported in the current releases of Linux.
ext3	This is an improved version of ext2. In case of an abrupt system shutdown, ext3 is much faster in recovering data and better ensures data integrity. You can easily upgrade your filesystem from ext2 to ext3.
ext4	The newest default filesystem for Linux distributions. It is backwards-compatible with the ext2 and ext3 filesystems. Among ext4's improvements over ext3 are journaling, support of volumes of up to one exbibyte (EiB) and files up to 16 tebibytes (TiB) in size

Managing Partitions and the Linux Filesystem

Filesystem Type	Description
reiserfs	This can handle small files efficiently. It handles files smaller than 1K and is faster than ext2. If appropriately configured, it can store more data than ext2.
vfat	This is a 32-bit filesystem and supports long file names. It is compatible with the FAT filesystem of Microsoft Windows XP and Microsoft Windows NT.
XFS	This is a 64-bit, high-performance journaling filesystem that provides fast recovery and can handle large files efficiently.
JFS	This is a 64-bit journaling filesystem that is fast and reliable. It is better equipped to handle power failures and system crashes.
swap	This is not a true filesystem, but rather is a portion of the hard disk that is used in situations when Linux runs out of physical memory and needs more of it. Linux pushes some of the unused files from RAM to “swap” to free up memory.

Managing Partitions and the Linux Filesystem

Filesystem Type	Description
ISO 9660	This is a filesystem standard defined by the International Organization for Standardization (ISO), and is also called a CDFS (Compact Disc File System). Linux allows you to access DVDs and CDs that use this filesystem.
FAT	The FAT (File Allocation Table) filesystem is compatible with different operating systems, including all versions of Windows, MS-DOS, and UNIX. It is primarily used for formatting floppy disks.
NTFS	NTFS (New Technology File System) is the recommended filesystem for Windows-based computers. NTFS provides many enhanced features over FAT or vfat, including file- and folder-level security, file encryption, disk compression, and scalability to very large drives and files.

Managing Partitions and the Linux Filesystem

Partitions

- A partition is a section of the hard disk that logically acts as a separate disk.
- Partitions enable you to convert a large hard disk to smaller manageable chunks, leading to better organization of information. A
- partition must be formatted and assigned a filesystem before data can be stored on it.
- Partitions are identified using a partition table, which is stored in the boot record.
- The partition table can contain entries for a maximum of four primary partitions.
- Partitions can be classified into primary and extended partitions.
- The size of each partition can vary but cannot exceed the total free space of the hard disk.

Managing Partitions and the Linux Filesystem

Hard Disk Size Specification

- Before proceeding with the installation process, you need to plan the hard disk layout based on your requirements. Each partition has a recommended size specification.

Partition	Recommended Size
/	Minimum 1 GB.
/boot	100 MB.
swap	Double the RAM size.
/var	Minimum 250 MB. If the possibility of the installation of many applications exists in the future, allocate the appropriate size.
/home	Varies based on the number of users.

Managing Partitions and the Linux Filesystem

Disk Partitioning

- Most operating systems, including Linux, use disk partitions.
- Data of different types can be stored in separate locations on the hard disk.
- The partition size can be specified by a user. However, the filesystem size must be considered before specifying the partition size.
- Disk partitioning enables the user to separate system files from user accessible ones.
- Corrupted partitions do not affect the other partitions, and they can be recovered separately.

Managing Partitions and the Linux Filesystem

Partition Types

Partition Type	Description
Primary	A disk partition that can contain one filesystem or logical drive and is sometimes referred to as volumes. A maximum of four primary partitions are allowed. The swap filesystem and the boot partition are normally created in a primary partition.
Extended	An extended partition can contain several filesystems, which are referred to as logical disks or logical drives. There can be only one extended partition, which can be further subdivided. This partition type does not contain any data and has a separate partition table.
Logical	A part of a physical disk drive that has been partitioned and allocated as an independent unit and functions as a separate drive. A logical partition is created within an extended partition. There is no restriction on the number of logical partitions, but it is advisable to limit it to 12 logical partitions per disk drive.

Managing Partitions and the Linux Filesystem

The fdisk Utility

- fdisk is a menu-driven utility program that is used for creating, modifying, or deleting partitions on a disk drive.
- Using fdisk, a new partition table can be created, or existing entries in the partition table can be modified.
- The fdisk utility understands the DOS and Linux type partition tables.
- Depending on the partition table created, the DOS FDISK or the Linux fdisk program is invoked.
- The fdisk utility also allows you to specify the size of partitions.

Managing Partitions and the Linux Filesystem

The fdisk Utility

- The syntax of the fdisk utility is *fdisk [options] {device name}*.

Option	Enables You To
`-b` *`sector size`*	Specify the number of disk sectors.
`-H` *`heads`*	Specify the number of disk heads.
`-S` *`sectors`*	Specify the number of sectors per track.
`-s` *`partition`*	Print the partition size in blocks.
`-v`	List the `fdisk` version.
`-l`	List partition tables for devices.

Managing Partitions and the Linux Filesystem

The fdisk Utility

- Some of the fdisk options are described in the following table.

Option	Enables You To
`n`	Create a new partition. The sub-options allow you specify the partition type and partition size.
`d`	Remove a partition.
`p`	List the existing partitions.
`w`	Write the changes to the disk and exit the utility.
`q`	Cancel the changes made and exit the utility.

Managing Partitions and the Linux Filesystem

The fstab File

- The fstab file is a configuration file that stores information about storage devices and partitions and where and how the partitions should be mounted.
- The fstab file is located in the /etc directory. It can be edited only by a root user.
- The fstab file consists of a number of lines—one for each filesystem.

Managing Partitions and the Linux Filesystem

The fstab File

- Each line in an fstab file has six fields, which are separated by spaces.

Field	Description
Device or partition name	Specifies the name of the device or filesystem that has to be mounted.
Default mount point	Indicates where the filesystem has to be mounted.
Filesystem type	Specifies the type of filesystem used by the device or partition.
Mount options	Specifies a set of comma-separated options that will be activated when the filesystem is mounted.
Dump options	Indicates if the `dump` utility should back up the filesystem. Usually, zero is specified as the `dump` option to indicate that `dump` can ignore the filesystem.
fsck options	Specifies the order in which the `fsck` utility should check filesystems.

Managing Partitions and the Linux Filesystem

The mkfs Command

The mkfs command is used to build a Linux filesystem on a device, which is usually a hard disk partition. The following table lists some options of the mkfs command and their description.

Option	Allows You To
`-v`	Produce *verbose* output, where the output message will keep changing constantly as the program is processing.
`-V`	Produce verbose output, including all filesystem-specific commands that are executed.
`-t {fstype}`	Specify the type of filesystem to be built.
`fs-options`	Pass filesystem-specific options to the filesystem builder.
`-c`	Check the device for bad blocks before building the filesystem.
`-l {file name}`	Read the list of bad blocks from a specified file.

Managing Partitions and the Linux Filesystem

The mkfs Command

If You Need To Build	Use This `mkfs` Command
An ext2 filesystem	`mkfs.ext2 /dev/`*`hdaPartition number`*
An ext3 filesystem	`mkfs.ext3 /dev/`*`hdaPartition number`*
An ext4 filesystem	`mkfs.ext4 /dev/`*`hdaPartition number`*
A reiserfs filesystem	`mkfs.reiserfs /dev/`*`hdaPartition number`*
A vfat filesystem	`mkfs.vfat /dev/`*`hdaPartition number`*
An XFS filesystem	`mkfs.xfs /dev/`*`hdaPartition number`*
A JFS filesystem	`mkfs.jfs /dev/`*`hdaPartition number`*

Managing Partitions and the Linux Filesystem

The mkfs Command

- The syntax of the mkfs command is *mkfs [filesystem type] [options] {device}.*

The mke2fs Utility

- *The mke2fs utility is used to create ext2, ext3, and ext4 filesystems, and it has various options. Some of the options are listed below in the following table.*
- *The syntax of the mke2fs utility is mke2fs [options] {device}*

Managing Partitions and the Linux Filesystem

The mke2fs Utility

- *Some of the options are listed below in the following table.*

Option	Enables You To
`-b {block size}`	Specify the size of the block in bytes.
`-c`	Check the device for errors in the blocks, before creating the filesystem.
`-f`	Specify the fragment size in bytes.
`-j`	Create a journaled ext3 filesystem.
`-M`	Set the directory that was last accessed for the filesystem to be mounted.
`-V`	Print the version number of the `mke2fs` utility.

Managing Partitions and the Linux Filesystem

The mkfs Command

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Thanks For Attention